REMARKS

In the Period for Reply portion of the Office Action Summary, no period for reply is stated. The undersigned briefly contacted the Examiner by telephone to inquire about the proper period for reply. The Examiner stated in this telephone conversation that the period for reply is 3 months, and that such indication was inadvertently not written in the Office Action Summary.

In part 12 of the Office Action Summary, none of the boxes are checked. However, the Applicants filed a certified copy of the priority document on 1 April 2004, as indicated on the filing transmittal for this application. Therefore, Applicants respectfully request acknowledgement of the claim for priority under section 119 and notice that the certified copy of the priority document has been received.

Applicants thank the Examiner for having returned an initialed copy of the PTO 1449 that was submitted on 1 April 2004.

Claims 1 – 42 are pending. Applicants respectfully request reconsideration and allowance of this application in view of the above amendments and the following remarks.

Claims 1, 2, 4, 6 – 15, 18, 19 and 21 – 42 were rejected under 35 USC 103(a) as being unpatentable over U.S. Patent Publication No. 2002/0056412 to Hara *et al.* (hereafter: "Hara"). Applicants respectfully request that this rejection be withdrawn for the following reasons.

Claim 1 recites the novel methodology disclosed, for example, on pgs. 18 – 20 for manufacturing a silicon carbide single crystal. The method comprises setting a silicon carbide single crystal substrate 13 as a seed crystal in a reactive chamber 11; introducing a raw material gas including a silicon containing gas and a carbon containing gas into the reactive chamber 11; growing a silicon carbide single crystal 21 from the silicon carbide single crystal substrate 13; heating the raw material gas at an upstream side from the silicon carbide single crystal substrate

13 in a gas flow path; keeping a temperature of the silicon carbide single crystal substrate at a predetermined temperature lower than the raw material gas so that the silicon carbide single crystal is grown from the silicon carbide single crystal substrate 13; heating a part of the raw material gas, which is a non-reacted raw material gas and does not contribute to crystal growth, after passing through the silicon carbide single crystal substrate; and absorbing a non-reacted raw material gas component in the non-reacted raw material gas with an absorber 4.

Hara discloses a method for producing a silicon carbide crystal in which a crucible, which has first member and second cylindrical body, is disposed in a lower chamber. A pedestal is disposed inside the first member, and a seed crystal is fixed to the pedestal. A second heat insulator is provided between an inlet conduit and a crucible. A first heat insulator is provided at a halfway portion of the inlet conduit. With these heat insulators, a temperature gradient occurs in the inlet conduit at a portion thereof that is closer to the crucible. A mixture gas is introduced into the crucible. The mixture gas is heated up gradually when passing through the inlet conduit and is introduced into the crucible to form silicon carbide single crystals in high quality.

However, as admitted by the Examiner, Hara fails to teach or suggest absorbing a non-reacted raw material gas component in the non-reacted raw material gas with an absorber.

The Examiner has asserted that it would have been obvious to one of ordinary skill in the art to determine through routine experimentation the optimum, operable means of controlling the gas flow out in order to prevent harmful gas emissions. Applicants respectfully disagree with this assertion that one skilled in the art would be motivated to use an absorber as recited. Particularly, the reasoning asserted by the Examiner is based on improper hindsight, as Hara does not teach or suggest the nature of the problem of controlling gas flow out in order to prevent harmful emissions. Rather, Hara discusses prevention of deposits of the mixture gas on the inner

surface of the first inlet conduit 50a by restraining the surface roughness Ra to reduce a contact area where the mixture gas contacts to the inner surface of the first inlet conduit 50a. Thereby the flow rate of the mixture gas near the inner surface of the first inlet conduit 50 is prevented from being lowered and the inlet conduit 50 is prevented from being plugged.

Further, absorbing a non-reacted raw material gas component in the non-reacted raw material gas with an absorber leads to superior results. A *prima facie* case of obviousness is rebutted by proof of unexpected or superior results. (See MPEP 2144.09 Aug. 2001). Particularly, as disclosed on, for example, pg. 20, the gas flow path is prevented from being plugged. As a result, the gas flow path including the reactive chamber 11 (i.e., the growth space) is not plugged with the deposited crystal, so that the crystal growth is performed stationary.

Therefore, because Hara fails to teach or suggest absorbing a non-reacted raw material gas component in the non-reacted raw material gas with an absorber, and because such a limitation leads to unexpected or superior results, it is respectfully requested that the rejection of claim 1 under 35 U.S.C. 103(a) be withdrawn.

Claims 2, 4 and 6 depend from claim 1. Therefore, the rejection of claims 2, 4 and 6 should be withdrawn for at least the above-mentioned reasons with respect to claim 1.

Claim 7 recites the novel methodology disclosed, for example, on pgs. 27 – 29 for manufacturing a silicon carbide single crystal. The method comprises: mounting a reactive chamber 11 in a vacuum chamber 10 in such a manner that the reactive chamber 11 is surrounded by a heat insulation 12 of the vacuum chamber; setting a silicon carbide single crystal substrate 21 as a seed crystal in the reactive chamber 11; introducing a raw material gas including a silicon containing gas and a carbon containing gas into the reactive chamber 11; growing a silicon carbide single crystal 21 from the silicon carbide single crystal substrate 11;

discharging a part of the raw material gas, which is a non-reacted raw material gas and does not contribute to crystal growth, after passing through the silicon carbide single crystal substrate 11; and removing a non-reacted raw material gas component in the non-reacted raw material gas in such a manner that the non-reacted raw material gas component is converted from a gas state to a solid state in the vacuum chamber 10 before the non-reacted raw material gas component is absorbed in the heat insulation 12.

Hara discloses that a crucible 30 is surrounded by a heat insulator 7. However, Hara fails to teach or suggest removing a non-reacted raw material gas component in the non-reacted raw material gas in such a manner that the non-reacted raw material gas component is converted from a gas state to a solid state in the vacuum chamber before the non-reacted raw material gas component is absorbed in the heat insulation.

Further, removing a non-reacted raw material gas component in the non-reacted raw material gas in such a manner that the non-reacted raw material gas component is converted from a gas state to a solid state in the vacuum chamber before the non-reacted raw material gas component is absorbed in the heat insulation leads to superior results. A *prima facie* case of obviousness is rebutted by proof of unexpected or superior results. (See MPEP 2144.09 Aug. 2001). Particularly, as disclosed on, for example, pg. 30, the raw material gas, which does not contribute to the crystal growth, is heated again, and then the gas is absorbed in the carbon heat insulation 12 as the absorber. Thus, the growth yield of the silicon carbide single crystal 21 is improved. Further, the gas flow path including the reactive chamber 11 (i.e., the growth space) is not blocked (i.e., plugged), so that the stationary crystal growth is provided. Furthermore, as discussed on pgs. 31 – 32, the results of the experiment demonstrate that silicon carbide absorbed by the carbon heat insulation 12 does not plug passages of the gas, so that the continuous crystal growth is performed in the recited embodiment.

Therefore, because Hara fails to teach or suggest removing a non-reacted raw material gas component in the non-reacted raw material gas in such a manner that the non-reacted raw material gas component is converted from a gas state to a solid state in the vacuum chamber before the non-reacted raw material gas component is absorbed in the heat insulation, and because such a limitation leads to superior results, it is respectfully requested that the rejection of claim 7 under 35 U.S.C. 103(a) be withdrawn.

Claim 8 recites the novel embodiment disclosed, for example, on pgs. 28 – 29 of equipment for manufacturing a silicon carbide single crystal. The equipment comprises: a reactive chamber 11 for accommodating a silicon carbide single crystal substrate 13 as a seed crystal, wherein a raw material gas including a silicon containing gas and a carbon containing gas is introduced into the reactive chamber 11 so that a silicon carbide single crystal 21 is grown from the silicon carbide single crystal substrate 13; a heater, such as the RF coil 20, for heating the raw material gas to be introduced to the silicon carbide single crystal substrate 13 up to a temperature higher than a temperature of the silicon carbide single crystal substrate; and an absorber 12, wherein the reactive chamber 11 has a construction in such a manner that a part of the raw material gas, which is a non-reacted raw material gas and does not contribute to crystal growth, flows toward a downstream side from the silicon carbide single crystal substrate after passing through the silicon carbide single crystal substrate, wherein the heater heats the part of the raw material gas after passing through the silicon carbide single crystal substrate, and wherein the absorber 12 absorbs a non-reacted raw material gas component in the non-reacted raw material gas after heating the part of the raw material gas.

Hara discloses an apparatus for producing silicon carbide single crystals that includes a crucible 30 serving as a reaction chamber. However, Hara fails to teach or suggest that the crucible 30 has a construction in such a manner that a part of the raw material gas, which is a

non-reacted raw material gas and does not contribute to crystal growth, flows toward a downstream side from the silicon carbide single crystal substrate after passing through the silicon carbide single crystal substrate. Rather, Hara discloses that the non-reacted raw material gas and does not contribute to crystal growth is exhausted from the silicon carbide single crystal substrate through a gap between the first member 31 and the cylindrical body 36. (See paragraph 39).

Further, as admitted by the Examiner, Hara fails to teach or suggest absorbing a non-reacted raw material gas component in the non-reacted raw material gas with an absorber. The Examiner has asserted that it would have been obvious to one of ordinary skill in the art to determine through routine experimentation the optimum, operable means of controlling the gas flow out in order to prevent harmful gas emissions. Applicants respectfully disagree with this assertion that one skilled in the art would be motivated to use an absorber as recited. Particularly, as discussed above with respect to claim 1, the reasoning asserted by the Examiner is based on improper hindsight reasoning, as Hara does not teach or suggest the nature of the problem of controlling gas flow out in order to prevent harmful emissions.

Therefore, because Hara fails to teach or suggest: the crucible 30 has a construction in such a manner that a part of the raw material gas, which is a non-reacted raw material gas and does not contribute to crystal growth, flows toward a downstream side from the silicon carbide single crystal substrate after passing through the silicon carbide single crystal substrate; and an absorber absorbs a non-reacted raw material gas component in the non-reacted raw material gas after heating the part of the raw material gas, it is respectfully requested that the rejection of claim 8 under 35 U.S.C. 103(a) be withdrawn.

Claims 9 – 15, 18 – 19 and 21 – 23 depend from claim 8. Therefore, the rejection of claims 9 – 15, 18 – 19 and 21 – 23 should be withdrawn for at least the above-mentioned reasons with respect to claim 8.

Claim 24 recites the novel embodiment disclosed, for example, on pgs. 38 – 47 of equipment for manufacturing a silicon carbide single crystal. The equipment comprises: a reactive chamber 11 disposed in a vacuum chamber 10; a heat insulation 12 for surrounding the reactive chamber 11; a silicon carbide single crystal substrate 13 as a seed crystal disposed in the reactive chamber 11; a tube 15 for introducing a raw material gas including a silicon containing gas and a carbon containing gas into the reactive chamber 11 so that a silicon carbide single crystal is grown from the silicon carbide single crystal substrate; and an absorber 519 disposed between an outlet of the reactive chamber and a heat insulation of the vacuum chamber, wherein a non-reacted raw material gas component in a non-reacted raw material gas, which does not contribute to crystal growth, is converted from a gas state to a solid state so that the non-reacted raw material gas component is absorbed in the absorber.

As admitted by the Examiner, Hara fails to teach or suggest absorbing a non-reacted raw material gas component in the non-reacted raw material gas with an absorber. The Examiner has asserted that it would have been obvious to one of ordinary skill in the art to determine through routine experimentation the optimum, operable means of controlling the gas flow out in order to prevent harmful gas emissions. Applicants respectfully disagree with this assertion that one skilled in the art would be motivated to use an absorber as recited. Particularly, as discussed above, the reasoning asserted by the Examiner is based on improper hindsight.

Further, an absorber disposed between an outlet of the reactive chamber and a heat insulation of the vacuum chamber as recited in claim 24 leads to superior results. A *prima facie*

case of obviousness is rebutted by proof of unexpected or superior results. (See MPEP 2144.09 Aug. 2001). Particularly, as disclosed on, for example, pg. 46, since the inert gas flows between the absorber 519 and the reactive chamber 11 and between the absorber 519 and the lower heat insulation 14 from the upper side, an emission path of the non-reacted raw material gas is prevented from being plugged.

Therefore, because Hara fails to teach or suggest absorbing a non-reacted raw material gas component in the non-reacted raw material gas with an absorber, and because such a limitation leads to superior results, it is respectfully requested that the rejection of claim 24 under 35 U.S.C. 103(a) be withdrawn.

Claims 25 – 30 depend from claim 24. Therefore, the rejection of claims 25 – 30 should be withdrawn for at least the above-mentioned reason with respect to claim 24.

Claim 31 recites the novel embodiment disclosed, for example, on pgs. 57 – 60 of equipment for manufacturing a silicon carbide single crystal. The equipment comprises: a reactive chamber 11 disposed in a vacuum chamber; a heat insulation 12 for surrounding the reactive chamber; a silicon carbide single crystal substrate 13 as a seed crystal disposed in the reactive chamber; a tube 15 for introducing a raw material gas including a silicon containing gas and a carbon containing gas into the reactive chamber 11 so that a silicon carbide single crystal is grown from the silicon carbide single crystal substrate; a space S1 for separating out a non-reacted raw material gas component in a non-reacted raw material gas, which does not contribute crystal growth, wherein the space is disposed in a place, temperature of which is gradually reduced, and wherein the space is surrounded by the heat insulation disposed in a gas flow path in the vacuum chamber, the gas flow path being disposed from an outlet 508a of the reactive

chamber 11 to an emission pipe 513 in the vacuum chamber for discharging the non-reacted raw material gas.

Hara discloses that a gap formed with the first member 31 and the second cylindrical body 36 is used as an exhaust portion. However, Hara fails to teach or suggest a space for separating out a non-reacted raw material gas component in a non-reacted raw material gas, which does not contribute crystal growth, wherein the space is disposed in a place, temperature of which is gradually reduced, and wherein the space is surrounded by the heat insulation disposed in a gas flow path in the vacuum chamber. Particularly, Hara only discloses heat insulator 7 and heat insulators 51, 52 in the inlet conduit 50.

Therefore, because Hara fails to teach or suggest a space for separating out a non-reacted raw material gas component in a non-reacted raw material gas, which does not contribute crystal growth, wherein the space is disposed in a place, temperature of which is gradually reduced, and wherein the space is surrounded by the heat insulation disposed in a gas flow path in the vacuum chamber, it is respectfully requested that the rejection of claim 31 under 35 U.S.C. 103(a) be withdrawn.

Claims 32 – 39 depend from claim 31. Therefore, the rejection of claim 32 – 39 should be withdrawn for at least the above-mentioned reasons with respect to claim 31.

Claim 40 recites the novel embodiment disclosed, for example, on pgs. 64 – 68 of equipment for manufacturing a silicon carbide single crystal. The equipment comprises a reactive chamber 11 disposed in a vacuum chamber 10; a heat insulation 12 for surrounding the reactive chamber; a silicon carbide single crystal substrate 13 as a seed crystal disposed in the reactive chamber 11; a tube 15 for introducing a raw material gas including a silicon containing gas and a carbon containing gas into the reactive chamber 11 so that a silicon carbide single

crystal 21 is grown from the silicon carbide single crystal substrate 13; and a separator 1180 for separating out a non-reacted raw material gas component in a non-reacted raw material gas, which does not contribute to crystal growth, wherein the separator is disposed in a part of a gas flow path in the vacuum chamber 11, the part of the gas flow path being disposed from an outlet 508a of the reactive chamber 11 to an emission pipe 513 in the vacuum chamber, wherein the emission pipe discharges the non-reacted raw material gas, wherein the part of the gas flow path has a temperature being gradually reduced, and wherein the non-reacted raw material gas component in the non-reacted raw material gas is separated out in a space S10 surrounded by another heat insulation 1181 in the separator.

Hara discloses that a gap formed with the first member 31 and the second cylindrical body 36 is used as an exhaust portion. However, Hara fails to teach or suggest a separator for separating out a non-reacted raw material gas component in a non-reacted raw material gas, which does not contribute to crystal growth, wherein the separator is disposed in a part of a gas flow path in the vacuum chamber, the part of the gas flow path being disposed from an outlet of the reactive chamber to an emission pipe in the vacuum chamber, wherein the part of the gas flow path has a temperature being gradually reduced, and wherein the non-reacted raw material gas component in the non-reacted raw material gas is separated out in a space surrounded by another heat insulation in the separator.

Further, a separator as recited in claim 30 leads to superior results. A *prima facie* case of obviousness is rebutted by proof of unexpected or superior results. (See MPEP 2144.09 Aug. 2001). Particularly, as disclosed on, for example, pg. 67, since the separator 1180 is vibrated, the adhered solid-state particle 852 is dropped down so that the space S10 is prevented from being plugged.

Therefore, because Hara fails to teach or fails to teach or suggest a separator for separating out a non-reacted raw material gas component in a non-reacted raw material gas, which does not contribute to crystal growth, wherein the separator is disposed in a part of a gas flow path in the vacuum chamber, the part of the gas flow path being disposed from an outlet of the reactive chamber to an emission pipe in the vacuum chamber, wherein the part of the gas flow path has a temperature being gradually reduced, and wherein the non-reacted raw material gas component in the non-reacted raw material gas is separated out in a space surrounded by another heat insulation in the separator, and because such a limitation leads to superior results, it is respectfully requested that the rejection of claim 41 under 35 U.S.C. 103(a) be withdrawn.

Claims 41 – 42 depend from claim 41. Therefore, the rejection of claim 41 – 42 should be withdrawn for at least the above-mentioned reasons with respect to claim 42.

Claims 3, 5 and 20 were rejected under 35 U.S.C. 103(a) as being unpatentable over Hara in view of U.S. Patent No. 5,704,985 to Kordina *et al.* Applicants respectfully request that this rejection be withdrawn for the following reasons.

Claims 3 and 5 depend from claim 1. Therefore, the rejection of claims 3 and 5 should be withdrawn for at least the above-mentioned reasons with respect to claim 1.

Claim 20 depends from claim 8. Therefore, the rejection of claim 20 should be withdrawn for at least the above-mentioned reasons with respect to claim 8.

Claims 16 and 17 were rejected under 35 U.S.C. 103(a) as being unpatentable over Hara in view of U.S. Patent No. 5,704,985 to Kordina *et al.* Applicants respectfully request that this rejection be withdrawn for the following reasons.

Claims 16 and 17 depend from claim 8. Therefore, the rejection of claims 16 and 17 should be withdrawn for at least the above-mentioned reasons with respect to claim 8.

In view of the foregoing, Applicants respectfully submit that this application is in condition for allowance. A timely notice to that effect is respectfully requested. If questions relating to patentability remain, the examiner is invited to contact the undersigned by telephone.

If there are any problems with the payment of fees, please charge any underpayments and credit any overpayments to Deposit Account No. 50-1147.

Respectfully submitted,

Kerry S. Culpepper

Kerry S. Culpepper
Reg. No. 45,672

Posz Law Group, PLC
12040 South Lakes Drive, Suite 101
Reston, VA 20191
Phone 703-707-9110
Fax 703-707-9112
Customer No. 23400